AP Statistics
Test: Inference for Porportions
Instructor's Version

Free Response: 2 questions, 52 points, 30 minutes

1. **A poll of 72 seniors, taken three weeks before the selection of the school Homecoming Queen, identified 60 who planned to vote for Jenny Wonderful. Unfortunately, a week after the poll was taken, the school newspaper ran an article that quoted Jenny slandering her opponents. Another poll of 80 seniors taken shortly after the article appeared showed that 56 planned to vote for Jenny. Does this indicate a significant drop in support for Jenny? Use good statistical reasoning to support your answer.** (25 points)

Answer:
A variety of approaches are possible here. Students should state a correct null and alternative hypothesis. They must justify the use of *z*-procedures for proportions. They may, but are not required to, state a significance level. They can approach the problem either with a confidence interval or a significance test. They must give a conclusion in context.

$$\hat{p}_1 = \frac{60}{72} = .83, \ \hat{p}_2 = \frac{56}{80} = .70$$

If the student uses a significance test to solve the problem:

$$\hat{p} = \frac{60+56}{72+80} = .76, z = \frac{.83-.70}{\sqrt{(.76)(.24)(\frac{1}{72}+\frac{1}{80})}} = \frac{.13}{.069} = 1.88 \qquad p = .03$$

Based on this, you would reject at the .05 level, and you would not reject at the .01 level. If no significance level is stated, the student should probably interpret this as evidence to reject.

If student uses a 95% confidence interval to solve the problem:

$$(.83 - .70) \pm (1.96)\sqrt{\frac{(.83)(.17)}{72} + \frac{(.70)(.30)}{80}} = .13 \pm 1.96(.068) = (-00, .26)$$

Note: Depending on how they round, the lower bound may be a small number that's close to zero.

Be careful how this is interpreted! Because zero is in this interval, we really can't argue convincingly against the null. However, this is an artifact of rounding – if students do the question on the TI-83, they will get <.001, .2656>. As you can see, now zero isn't in the interval. The conclusions will vary depending on what approach they take and how they do the mechanics – there could be several different correct answers.

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2. You're interested in the proportion of students in your school who favor the elimination of a local curfew on teenagers. Assume your school has 1,000 students.

A. To generate a 95% confidence interval for the proportion of students who favor the elimination of a curfew, what's the minimum number of students you need if you want the margin of error to be 5%? (9 points)

Answer:
Since there is no indication of a guess at a population proportion, we must assume $p^* = .5$. Thus $n = \left(\frac{1.96}{2(.05)}\right)^2 = 384.16$. So we would need a minimum of 385 students in our sample. The student can be given extra credit if they point out that the margin by which the population is larger than the sample really isn't enough to justify *z*-procedures in this problem.

B. Suppose your principal, who never took a statistics class, says that a 5% margin of error just isn't accurate enough. He wants you to produce a confidence interval with a margin of error of only 2.5%. How big does your sample have to be now? What do you think of the principal's proposal? (9 points)

Answer:
$n = \left(\frac{1.96}{2(.025)}\right)^2 = 1{,}536.64$, so we need a sample of 1,537 students. We shouldn't think much of the principal's proposal since this number is greater than the number of students in the school.

C. In general, if you wanted to cut the margin of error for a given confidence level in half, by what amount would you have to increase the sample size? Use the formula for minimum sample size to explain your answer. (9 points)

Answer:
Let n = the original sample size, n^* = the new sample size.

$$n = \left(\frac{z^*}{2m}\right)^2 = \frac{z^*}{4m^2},\ n^* = \left(\frac{z^*}{2(1\ 2\ m)}\right)^2 = \frac{z^{*2}}{m^2} \qquad n^* = 4n$$

You would need to multiply the sample size by 4 in order to cut the margin of error in half.

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